



p. 27.

Shall We Continue

—TO USE THE—

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Sewage Polluted  
Passaic;

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—OR SHALL WE GET—

Pure Water?

[LEEDS]

WAA

L 4836s

1887

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Red lines indicate sewers and drains discharging into Passaic River  
The sewage is from 250,000 people



This Arrow shows how far up stream  
The sewage of Newark is backed  
by the incoming tide

- References to Map
- Populated Area.....
  - Sewers and Drains.....
  - Unpolluted Water.....
  - Water Polluted by sewage.....
  - Water Polluted by sewage  
and Tide water.....
  - Contemplated Sewers,  
at Passaic.....
  - Houses.....

MAP SHOWING  
THE  
SOURCES OF POLLUTION  
OF THE PRESENT  
WATER SUPPLY  
OF  
JERSEY CITY  
AND  
NEWARK

Scale one mile-one inch.





20-  
AA

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JERSEY CITY PRINTING COMPANY,  
37 Montgomery Street.

[Article taken from "The Sunday Eagle" of May 29, 1887.]

# PESTILENTIAL!

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WE ARE DRINKING FOUL SEWAGE WATER.

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CONVINCING PROOF AS TO THE FILTHY STATE OF OUR WATER SUPPLY

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PROFESSOR LEEDS' REPORT, BASED UPON THE EXPERIENCE OF  
YEARS AND HUNDREDS OF ANALYSES.

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*The Eagle, Backed by a Large Body of Our Leading Citizens,  
Calls for a Scientific Opinion upon the Character of the  
Water We Drink--The Answer Has Been Given, and the  
Citizens Will Now Insist on Having Purer Water.*

---

*The Eagle*, ever seeking to obtain the best sources of information upon the subjects of which it treats, and knowing the great interest which all our citizens take in everything relating to our water supply, two weeks ago determined, if public sentiment favored it, to obtain the best scientific opinion upon the subject. Starting out with a petition for our leading citizens to sign, it found that the community was fully aroused upon the subject, and that every gentleman asked, with the exception of three, cheerfully signed the petition printed below, requesting Professor Leeds, the well-known chemical expert, and Chairman of the Committee of Analysis of the New Jersey Board of Health, to give his scientific opinion as to the character of the water we drink. The report, one of vital interest to every citizen in Jersey City, together with the names of the gentlemen who requested it, are printed below. Professor Leeds' letter speaks for itself, and it now lies with our citizens to take some action which shall save them from drinking the foul water which we are compelled to use. The report is one of interest, and although



lengthy, will amply repay the reader for a thorough perusal. The questions answered by the Professor were propounded by *The Eagle* in a form which when answered would best solve the matter in doubt. The map prepared by the Professor, and which accompanied the report, we were unable to prepare for publication with this report. It is now at *The Eagle* office, where any citizen may examine it.

In the popular mind there is no doubt at all as to the filthy character of the Passaic water. From interviews with the leading physicians, clergymen, business men and other prominent citizens, it was seen that almost without exception the residents of Jersey City are convinced that our drinking water is wholly unfit for use. The proof of this is found in the fact that thousands of our citizens never drink the Passaic water under any circumstances, and that thousands of others use it only after the water has been filtered and boiled, and then very sparingly. Strange to say, however, there are still a few persons who are unwilling to believe the evidence of their senses, or the testimony of medical men; and for the benefit of this class, as well as for the purpose of setting the question of the impurity of the Passaic water finally at rest, we have called for the opinion of Professor Leeds, whose word on the water question is to be taken as practically decisive.

#### PETITION AND SIGNATURES.

JERSEY CITY, May 12, 1887.

The question of water supply is at the present time of vital importance to the people of Jersey City. There is reason to believe that the water taken from the Passaic River is unfit for use, if not actually dangerous to health, and therefore, it is imperative that some determination should be had as to its exact character and purity.

If the water is bad, the people ought to know it, in order that necessary precautions may be taken against the evils which must flow from its constant use; whereas, if it is wholesome, or even harmless, as many claim it is, the fact should be known and communicated to the public, in order that fears which now exist may be allayed, and that all may partake unsparingly and fear-



lessly of that which, with air and sunshine, is an essential life-supporting element.

*The Sunday Eagle*, in the interest of public health, and for the welfare of Jersey City, desires that the exact truth as to the condition of the Passaic water should be laid bare. It desires and hereby requests that a scientific opinion be expressed on the subject by the highest authority; and without doubt the foremost water chemist in the country is Albert R. Leeds, Professor of Chemistry in Stevens Institute of Technology, in Hoboken. Professor Leeds has, since its formation in 1881, until recently, acted as chemist to the Joint Board of Pollution of Newark and Jersey City. He has from time to time, for the past fifteen years, analyzed the water taken from the Passaic River, under all sorts of conditions and circumstances, and is certainly, beyond any other man, qualified to know whether the water is pure or impure, wholesome or otherwise.

The undersigned citizens of Jersey City, freely commending the public-spirited course pursued by *The Sunday Eagle* in this important water question, do most earnestly request that Professor Leeds express his opinion as to the character of the Passaic River water for drinking purposes:—

(Signed),

James Flemming, 82 Grand street.

Frank O. Cole, Grand street and Summit avenue.

Theo. F. Morris, M. D., 301 Varick street.

J. H. Vondy, M. D., 112 Mercer street.

J. W. Hunt, M. D., 311 Varick street.

J. D. McGill, M. D., 126 Grand street.

John Lochner, M. D., 583 Jersey avenue.

L. J. Gordon, M. D., 300 Grove street.

W. P. Watson, M. D., 319 York street.

James Paul, M. D., 207 Pavonia avenue.

Conrad Wienges, M. D., 649 Jersey avenue.

A. J. Holcombe, M. D., 659 Jersey avenue.

J. H. Finnerty, M. D., 210 Pavonia avenue.

F. D. Gray, M. D., 124 York street.

J. D. Burdett, M. D., 535 Summit avenue.

- F. E. Noble, M. D., 31 Hoboken avenue.  
 J. Wellman Clark, M. D., 100 Mercer street.  
 Daniel Murray, M. D., 501 Communipaw avenue.  
 Rev. S. M. Rice, D. D., 184 Summit avenue.  
 Mgr. Robert Seton, D. D., pastor of St. Joseph's Church.  
 Rev. Geo. P. Hebbard, rector Holy Trinity Church.  
 Rev. J. W. Hathaway, pastor Westminster Presbyterian Church.
- T. C. Brown & Van Anglen, 21 Newark avenue.  
 Furst Bros., 52 Newark avenue.  
 Edward Hoos, 266 Third street.  
 Hoos & Schulz, 71-73 Newark avenue.  
 Marshall & Ball Co., 58-60 Newark avenue.  
 E. J. Norris, 9 Montgomery street.  
 Turner & Bennell, 23-25 Newark avenue.  
 W. F. Taylor, 12 Sussex Place.  
 A. S. Jackson, 45 Wayne street.  
 John Mullins & Co., 121 Newark avenue.  
 Theo. Gubelman, 79 Newark avenue.  
 Wm. Winchester, 131 Sip avenue.  
 Morrow, Day & Co., 81 Montgomery street.  
 Job. H. Lippincott, 617 Pavonia avenue.  
 F. C. Wolbert, 47 Montgomery street.  
 P. W. Levering, 588 Newark avenue.  
 W. R. Laird, 250 Washington street.  
 P. H. Hanley, 41 Newark avenue.  
 C. P. Friend, 141 Sussex street.  
 Wm. Loughlin, 120 York street.  
 J. W. Knause, 101 Montgomery street.  
 E. Sands, 87 Montgomery street.  
 E. R. Wessels, 30 Newark avenue.  
 Abram Post, 255 Warren street.  
 R. Scarboro, 94 Montgomery street.  
 C. L. Van Antwerp, 9 Madison avenue.  
 Henry Thompson, 48-50 Montgomery street.  
 W. J. Montgomery, 58 York street.  
 R. W. Elliott, 69 Montgomery street.  
 P. M. Hall, 56 Montgomery street.



- F. M. Hayes, 15 Newark avenue.  
Hugh Coyle, 532 Jersey avenue.  
Geo. K. Campbell, 46 Montgomery street.  
Frank Stevens, 55 Montgomery street.  
Earl B. Silvers, 5 Montgomery street.  
G. W. Phillips, Grove street and Newark avenue.  
Warren & Mahony, 201 Morgan street.  
Walter H. Elliott, 30 Laidlaw avenue.  
James Roche, 338 Grove street.  
Thos. Mahony, 255 Eighth street.  
F. G. Smith, 43 Montgomery street.  
G. F. Holmes, 2 Park street.  
Wm. Dohrmann, 152 Newark avenue.  
John Duffy, 27 Montgomery street.  
A. Zabinski, 72 Newark avenue.  
Greene & Donnelly, 77 Newark avenue.  
W. H. Ewald & Bro., 156 Newark avenue.  
Joseph W. Kidd, 127 Newark avenue.  
Frank J. Hanly, 203 Newark avenue.  
Enoch Kessler, 12 Newark avenue.  
Samuel Taylor, 107 Montgomery street.  
Denis Reardon, 202 Pavonia avenue.  
Petter & Simpson, York and Warren streets.  
Wm. N. Baron, 6 Newark avenue.  
Warner & Carscallen, 18 Newark avenue.  
George H. Carrick, 19 Newark avenue.  
James F. Gannon, 107 Sussex street.  
W. J. Seeley, 84 Montgomery street.  
James Chapman, 259 Washington street.  
George Dompierre, 88 Newark avenue.  
Wm. H. Hunt, 90 Newark avenue.  
Thos. Fitzsimons, 119 Newark avenue.  
J. Rocheford, 133 Newark avenue.  
Henry V. Piaget, 377 Bergen avenue.  
Patrick Kelly, 132 Newark avenue.  
Wm. J. Rouget, 345 Grove street.  
W. H. Storm, 305 Second street.  
F. H. Spengeman, 256 Washington street.

George Blakey, 259 Warren street.  
William Symes, 29 Newark avenue.  
Philip Morris, 108 Newark avenue.  
John J. Keane, 64 Newark avenue.  
Thos. F. Noonan, Jr., 43 Van Winkle avenue.  
Beach Bros., 572 Newark avenue.  
A. B. Costello, 588 Newark avenue.  
Kinkead Bros., 608 Newark avenue.  
R. Lahey & Bro., 622 Newark avenue.  
Charles F. Staib, 471 Newark avenue.  
Joseph E. Dean, 591 Summit avenue.  
W. H. Farrar, 630 Newark avenue.  
Beck Bros., 662 Newark avenue.  
Louis Schmidt, 666 Newark avenue.  
John Lucey, 244 Ogden avenue.  
J. W. Schanck, 58 Montgomery street.  
Philip Muldoon, 362 York street.  
G. A. Sofield, 88 Montgomery street.  
John J. Minihan, 176 Pavonia avenue.  
A. Walker Dakin, 79 Newark avenue.  
Thos. H. McDonough, 261 Warren street.  
H. E. Howell, 283 Barrow street.  
W. D. Ives, 283 Barrow street.  
John A. Vill, 550 Jersey avenue.  
E. A. Dugan, 342 Grove street.  
M. J. Boylan, 494 Grove street.  
Wm. Winberry, 59 Newark avenue.  
Wm. Ditmar, 85 Newark avenue.  
Wm. Hartnett, 142 Newark avenue.  
L. P. Hansen, 77 Montgomery street.  
John Dunn, 548 Newark avenue.  
Michael Connelly, 573 Newark avenue.  
Thomas F. Murray, 89 Newark avenue.  
Edward Doyle, 144 Newark avenue.



## PROFESSOR LEEDS' LETTER.

COMMITTEE OF ANALYSTS OF THE NEW JERSEY STATE BOARD OF  
HEALTH.

OFFICE OF DR. ALBERT R. LEEDS, Chairman of Com.

STEVENS INSTITUTE OF TECHNOLOGY, }  
HOBOKEN, N. J., May 26, 1887. }

H. McAlester, Esq., Manager, Sunday Eagle :—

SIR:—I am in receipt of your favor of the 19th inst., inclosing a request signed by a very large number of the prominent citizens of Jersey City, that I should give distinct and positive answers to certain questions concerning the wholesomeness or otherwise of the present water supply from the Passaic River. I cannot feel otherwise than highly gratified by this expression of confidence and esteem, and take great pleasure in complying with your and their request, to the best of my knowledge and ability.

With reference to your own question as to the amount of your indebtedness to me for the work performed in this report, I would say there is no charge. I am a State officer directly charged with the responsibility of seeing that the provisions of the State law concerning the Adulteration of Food and Drink are complied with, and I know of no article of drink so important, or no article, the adulteration of which is so dangerous to health, as DRINKING WATER.

Very respectfully,

ALBERT R. LEEDS.

## PROFESSOR LEEDS' REPORT.

### QUESTION FIRST.

*What are the principal sources of the pollution of the water supply of Jersey City and Newark at the present time? Give as nearly as you can the amounts of the various polluting materials entering the Passaic River below the Great Falls at Paterson?*

### ANSWER.

In order to render my answer intelligible, I have prepared a map which shows the changes that the waters of the Passaic River undergo, from their bright and limpid condition above the Great Falls to their foul and turbid condition when discharged into Newark Bay.

*First Source of Pollution.*—Representing their natural condition of purity by the blue shading, I show them running the gauntlet of the sewers at Paterson, the sewers being so numerous and so close together that it was hard to find room on the map for the crimson lines, each crimson line representing a sewer. The city of Paterson, which is represented by the large brown patch, has grown with great rapidity, having already a population of about 70,000. And this rapid growth means not merely an increase in the number of people sewerage into the river, but an enormous growth of factories, each of which pours out its own peculiar filth. There are more and more cotton mills and woolen factories, great locomotive works, a jute mill, silk and silk dyeing establishments, with other factories too numerous to mention, employing all told over seven thousand operatives, and every day pouring forth millions of gallons of brilliantly colored and poisonous dyestuffs into the river. *The city is rapidly extending its sewer system, and fœcal matter which formerly was held in cesspools is now being discharged into the river. There are already 28 miles of sewers, emptying by 13 large outlets, to say nothing of canals, tail races and private drains innumerable.*



*Second Source of Pollution.*—After getting by the houses and cemetery, and flowing over the Dundee Dam, the waters of the Passaic encounter the leakages of the oil tanks belonging to the Oil Storage Station opposite the city of Passaic.

These great tanks have a storage capacity of about 160,000 barrels, and are so located that, as I have represented by the red lines, all the leakages of oil and the drainage therefrom empties directly into the Saddle River and thence into the Passaic. Still worse, a number of breaks have occurred in the pipe line crossing the Saddle River, and the oil escaping from these bursts has covered the surface of the water for miles down the river.

*Third Source of Pollution.*—The city of Passaic has no public system of sewers, so that comparatively few are represented on the map. A system, however, has lately been adopted by the city authorities *which contemplates the immediate building of about thirteen miles of sewers, with seven large outlets directly into the Passaic River; ordinances for the building of sewers were passed in 1884 and again in 1885, and the matter is being strongly agitated at the present time by the 10,000 citizens of Passaic.* There are six large mills and a chemical factory employing about 5,500 operatives. The surface drainage of the city, together with much of the refuse and waste dyes of these mills, empties into the tail race of the Dundee Works, and thence into the river, and also into the Passaic River directly. This is still the case, though much has been done by the manufactories to abate some of the more dangerous nuisances.

*Fourth Source of Pollution.*—This is the Third River. It rises in a great spring just beyond the Notch in the First Mountain, which pours out 200,000 gallons of exquisitely limpid water that the town of Montclair has long coveted in vain for its domestic supply.

It is presently defiled by the refuse of Oakes' Woolen Mills, and by the Manila Paper Factory at Bloomfield, and by the Morris Canal, which crosses the Third River at this point, and pours its waste into it. Then comes the refuse of Davies' Paper Mill; then the slops and washings from the dyed yarns, etc., of Underhill's Woolen Knitting Mill. After that the spent dye-

stuffs from Duncan's Woolen Mills, and finally, the chloride of lime and other chemicals from the Kingsland Paper Mill. The mountain spring by this time has become a large sewer, and after having collected the drainage of the village of Franklin and part of the town of Bloomfield, it pours the accumulated *filth cast into it during its downward course of ten miles directly into the Passaic, at a point about two and a half miles above the Jersey City Intake and only a mile and a quarter above the Newark Intake.*

*Fifth Source of Pollution.*—This is the town of Belleville, with its 3,500 inhabitants. It has no sewers, but a large number of drains, which carry off the surface drainage and the contents of its sinks and cesspools into the Passaic River directly opposite the Jersey City Intake.

*Sixth Source of Pollution.*—This is the Second River. It is about five miles in length, rising in the vicinity of West Orange, and flowing through the towns of Orange, Watsessing, Bloomfield, and the village of Soho, into the Passaic River at a point about a quarter of a mile below the Jersey City Intake. *This is one of the worst sources of pollution of the Jersey City and Newark water supplies. There is a population upon the area of drainage of this stream of about 8,000 people. At Orange there are several large hat factories, employing about 4,000 hands, and the chemicals and dyes used in the manufacture of hats in these factories, all wastes into Second River. At Watsessing is Seabury & Johnson's Porous Plaster Factory, which empties its refuse chemicals into this river. Here also Tony's Brook empties into Second River. This large brook of five miles in length rises below the Great Notch and drains the villages of Montclair, Ridgewood and part of Bloomfield. There are three factories upon it—first, Moffett's Rolling Mill, discharging waste acids used in the washing of copper, brass, etc.; second, Wheeler's Paper Mill, which manufactures straw board, and wastes the refuse of a composition of chloride of lime decomposed reeds and straw into the river; third, Krump's Label Factory. This factory wastes arsenic and other deleterious chemicals and high colors, used in label printing, into the brook. From the junction of Tony's Brook with Second River to where*



Second River empties into the Passaic River there are three factories—first, Chemical Works, near Bloomfield ; second, Hendrickson's Copper Rolling Mills, and third, DeWitt's Copper Wire Mills. Various chemicals, washings of the wire, and other factory products, pour from these three into Second River.

*Seventh Source of Pollution.*—Unhappily this is the city of Newark itself. It has a population of about 160,000, and the entire sewerage of the city proper, with about sixty miles of sewers, empties directly into the Passaic. The population of East Newark is about 7,000, and this mostly sewers directly into the river. There are seven large public sewers and a great number of private drains emptying into the river at Newark. The distance from the nearest of the large sewers of Newark to the Jersey City Intake is about two and a half miles. This is the Fourth avenue four-foot sewer.

*Twice every twenty-four hours the tide carries the sewage of Newark up the river past the Jersey City and Newark Intakes, the salt water penetrating above the Jersey City Intake and nearly to the Newark Intake, the sewage, however, being forced far beyond that point by the backing up of the tide. (See map.)* In addition to these chief sources of pollution, there is a large population scattered along the river and its tributaries between Paterson and Newark, the surface drainage of which finds its way *into the river eventually. There are also two cemeteries, the Mt. Pleasant at Newark, and Cedar Lawn at Paterson, both of which immediately adjoin the river, and are situated on gravel beds which slope toward the river from elevations varying from 50 to 100 feet.*

For many of these interesting facts I am indebted to Mr. James Courter, who was Inspector for the Joint Board of Pollution from the date of its formation in 1881 until the year 1885. He also informs me that he was accustomed to take out of the river, during the course of every year, at least a hundred sheep, goats, cattle, horses, dogs and hogs.

## QUESTION SECOND.

*To what extent has the pollution been increased since you were first called upon by the Board of Public Works of Jersey City, in the year 1872, to make analyses of the Passaic water?*

## ANSWER.

I find stated in my report made to Mr. Andrew Clerk, that "the water during the midsummer of 1872 was highly offensive both to smell and taste; was turbid from the presence of great numbers of microscopic vegetable and animal organisms, and revealed, when proper chemical tests were applied, a shocking degree of contamination by organic matter." Details are given in this report of analyses of samples collected on the low and high tide at the Jersey City Intake, at a point above the Paterson High Falls, and from the Jersey City Reservoir. These analyses pointed to the existence of serious sewage contamination. And in bringing them to the notice of the Board of Public Works, Andrew Clerk, as chairman, says: "The Special Committee have to report that, after a careful examination, they are satisfied that the subject is of such vital importance as to demand critical consideration. As the waters analyzed were taken at the most favorable season of the year, and under circumstances calculated to give the best results attainable, your committee would suggest the propriety of further examination during the months of July and August, so that, by comparison, the accuracy of the various conclusions may be tested *and the maximum of impurities and deterioration determined upon.*"

I have italicised the concluding remarks of the report, because from this time forth the fact of the existence of impurities and deterioration was acknowledged, and the chief concern was to determine how great and how serious such deterioration might be.

The next information of an official character was obtained during the year 1873, under the terms of "An act to authorize the appointment of Commissioners to ascertain the probable cost and the best means of supplying the city of Hoboken and other northern portions of the county of Hudson with pure and whole.

some water." These Commissioners procured the waters of the Passaic River and the Hackensack River, to be analyzed by Prof. A. K. Eaton, and so unfavorable was the report of the chemist to the purity of the Passaic, at Belleville, that on the *ground of its impurity, more than for any other reason*, they decided against the Passaic River and in favor of the Hackensack. They say: "The source of supply, known as the Passaic scheme, recommends itself to this Board—first, because this source is deemed practically inexhaustible; second, because it is considered cheapest, costing, as per annexed report, some \$550,000 less for a given quantity of water, etc." The objections to this scheme are—first, the impurities that now exist in the waters of the Passaic, as compared with the waters of the Hackensack (see analyses), and the certainty that these impurities will be rapidly on the increase in a far greater ratio than they are likely to be increased in the waters of the Hackensack. These impurities in the Passaic will certainly render necessary, in the near future, the construction of filtering basins, etc."

Hoboken and the adjoining cities did not avail themselves of the recommendations of Mr. Kirkwood and the other eminent men associated with the Commission, though their labors had been performed at a cost to these communities of \$10,000. Hoboken continued to purchase Passaic water from Jersey City until 1881, notwithstanding the outcry became louder year by year against the bad taste and odor of the article purchased. But the Council in Hoboken would not or could not do anything, and it was not until 1881 that Hoboken had relief. Then the Hackensack Water Company brought in a supply of pure, sparkling, wholesome water, amounting to four million gallons a day, from its pumping station at New Milford, on the Hackensack River. There has never been a word of complaint against the purity and wholesomeness of the new Hoboken supply, except during the drought in the summer of 1884. Then the water became offensive from the growth of water-plants in the reservoir. The bad taste was done away with, and the plants ceased to grow, as soon as the water was thoroughly aerated, and, inasmuch as this practice of forcing air into the water increases its sparkle and brilliancy, it has been continued ever since.



Whilst Hoboken and the northern portion of Hudson County for the past five years have reaped the great benefits to life, health and property from carrying into practice the recommendations of its Commission, Newark and Jersey City have been less fortunate. In 1878 the former city, at a cost of many thousand dollars, procured the very trustworthy and elaborate "Report on Additional Water Supply," to be made by Messrs. Croes and Howell. These engineers carefully inquired into and tabulated the various sources of pollution of the Passaic water below the Great Falls at Paterson, such as sewers, woolen, cotton, silk mills, dye houses, factories, etc., and believed themselves *warranted at that time, nine years ago, in condemning it on account of its demonstrable contamination by filth and refuse of every description.*

The startling array of statistics presented in this report caused very general alarm, and this had not subsided before an occurrence happened which led to the first practical steps to restrain the growing evil. In the spring of 1880 the Passaic water became most disagreeable and offensive on account of carbolic acid derived from refuse thrown in at Kingland's Paper Mill. The defense set up the plea, and brought in a vast deal of evidence to show, that the water of the Passaic was already so foul that the carbolic acid they had emptied into it made no appreciable addition to the gross amount of pollution already existing; that, in fact, the emptying into it of a powerful disinfectant and deodorizer like carbolic acid, made it *less* foul and dangerous to health. But these grounds of defense were not considered valid by the court, and the case having been decided against the polluters, the Newark Aqueduct Board addressed itself vigorously to further action. After various preliminary meetings, on the 27th of October, 1881, a joint committee of six members, three from this Board and three from the Board of Public Works of Jersey City, held their first session under the able presidency of Dr. Lott Southard, and began an energetic warfare against the parties polluting the water supply.

On entering upon my duties as consulting chemist of this committee, I made a comparison of the water supplies of eleven cities, the samples being all collected on or about the 23d of

June, 1881, and found that in respect to quality the water of two cities only, viz., Brooklyn and Rochester, were satisfactory. These stood at the head of the list, and then followed Philadelphia, Baltimore, Washington, New York, and in the seventh place Newark and Jersey City. Since that time I have had occasion to make many hundred analyses of the Schuylkill water supplied to the city of Philadelphia, and have reported it as grossly polluted by the factories of Manayunk, located seven miles above the Fairmount Pumping Station. The vital statistics of Philadelphia show that its percentage of deaths from typhoid fever is very large, much larger than in many cities otherwise less salubrious than this so-called "City of Homes," and this great mortality from typhoid fever is generally and popularly attributed to its sewage-polluted water supply. But Manayunk, though a town of woolen and cotton mills, dye houses and factories, like Paterson and Dundee, is a much smaller place than Paterson, and dangerously polluted as the Schuylkill water is, it is certainly of better average quality than that supplied to Newark and Jersey City. Compare these figures (which give the average composition in 100,000 parts) of the Schuylkill River—I., at Phoenixville, where it is nearly, though not quite, pure, with II., the same stream at Spring Garden Pumping Station after it has received the sewage of Manayunk; and this again with the still more polluted waters of the Newark and Jersey City intakes, No. III.

	I.	II.	III.
	Philadelphia water before receiving Manayunk sewage. Mean of 17 analyses. Made in 1883-1886.	Philadelphia water after receiving Manayunk sewage. Mean of 59 analyses. Made in 1883-1886.	Jersey City water after receiving Paterson, Dundee and Newk's sewage. Mean of 50 analyses for the whole year of 1884.
Free ammonia.....	0.0035	0.008	0.01
Albumoid ammonia....	0.0097	0.015	0.022
Nitrous acid.....	0.00012	0.0006	0.0002
Nitric acid.....	0.369	0.39	0.53
Oxygen required to oxidize organic matter...	0.188	0.22	0.53
Chlorine .....	0.324	0.523	0.93

A mere inspection of these figures tells the story. It is useless to go into technical details, which would be as unintelligible as medical terms are to the layman, but these figures mean that on the most favorable calculation which can be made, *the water flowing into the intake of the Jersey City Pumping Station each day contains a great weight of sewage.*

It is certain that if the contents of the sewers and dye houses of Paterson were delivered directly into the pumping engines at Belleville, no citizen would willingly taste or smell, much less drink, the disgusting compound. What becomes of all this sewage, and of that additional load dumped into the river at Dundee and many points lower down? This was the question the Board of Pollution asked me to study in November, 1881. I answered it by making analyses of the pure water, etc., of the Passaic as collected above the Great Falls, and of forty-four samples taken at equal intervals down the river as far as Newark. The samples taken above the Great Falls were "sweet tasting and limpid," those immediately below Paterson were a "bluish-red liquid."

*The analyses show that at that time no less than twenty-five tons per day of sewage and refuse matter were added to the Passaic as it flowed past the sewers of Paterson.*

In the course of its flow down the river, the dirt and solid particles going to the bottom, and the urine and faecal matters breaking up into ammoniacal compounds, nitrates, and so forth, a great change took place. As we approached Dundee Dam, the impurities diminished. I stated that at the same *rate* of improvement, the water sixteen miles below Paterson would not have differed materially from its composition above Paterson. But at Passaic it was again befouled. And so it came to pass, that while above the Great Falls the volatile and organic matters were only 0.875 grain per gallon, they increased to 3.21 grains at Paterson. Then, at a point a short distance above Dundee Dam, they had diminished to 1.52 grains. After receiving the refuse of Passaic they increased to 3.26 grains, and then diminished



again until they amounted to 2.16 grains at a point above the Newark Intake opposite the Third River. From this point on, they increased again until at the Newark Intake at low-tide *they amounted to 3 grains, and on the high-tide, to 6.6 grains. At the Jersey City Intake on the same day they were 5 grains, and on the high-tide, 12.5 grains. Each day the river at, or a little above, Belleville carried down with it 30 tons of sewage and refuse.*

The sea salt held in solution by the tidal waves backing up the stream, and making their influence felt even so far up as Passaic, amounted to 32.59 grains per gallon. Out of every million gallons of water pumped at the Jersey City Intake 30,000 gallons were sea water. The reason why the Jersey City water was then, and usually is, so much worse than that supplied in Newark, is due to the out-pouring of the Newark sewers.

*The high-tide sweeps this sewage directly up against the Jersey City Intake.*

Comparatively little sea water reaches the Newark Intake except at seasons of drought. Then there is more, the *sea water* backing up the river being greater in volume than the *fresh water* coming down.

This certainly was a nasty condition of affairs. As early as 1873 the analyses of Prof. Wurtz had shown a great deterioration in the water pumped at Belleville as compared with its quality in 1872, and as it was before the removal of the bar between the pumping stations and Newark by the United States Government. In the report of Croes and Howell, estimates are given of the cost of the various schemes for protecting the Passaic from sewage pollution. To shut off the filth flowing *up* the river from the Newark sewers it was proposed to build a dam at Belleville; to keep out the sewage coming *down* the river it was proposed to build an intercepting sewer along its shore from Paterson to the dam. A most strenuous effort was made in February, 1882, to secure the passage of a bill by the Legislature which should authorize damming the Passaic. The effort failed, and since *that time the people of Newark have drunken much of their own sewerage, but a very much larger share has gone into the Jersey City water.*

Unsuccessful in this direction, the Board of Pollution directed its entire energies to abating the nuisances located up the river. During the year 1882 the water closets connected with mills at Passaic, employing 2,200 hands, were disconnected with the stream and their sewage disinfected in tanks by chemicals. Similar changes were effected, through the labors of the Sanitary Inspectors, at Avondale, Belleville and along the course of the Second and Third Rivers and Tony Brook. The carcasses of eighty dogs, together with other animals found floating in the river, were removed and buried.

In referring to my analyses made for the Board, I find that I speak of the water as exhibiting in the month of October of this year, "a lamentable degree of impurity." In consequence of the very prolonged drought in the autumn of 1881, the water became very impure and remained so up to the month of December. After attaining its condition of maximum purity in the months of February and March, the Newark water remained of excellent quality until the month of May, when it had so far deteriorated as to contain 0.0245 parts per 100,000 of albuminoid ammonia, and passed from the category of pure to that of impure waters. The deterioration in the Jersey City water was still more rapid and decided.

During the winter and spring of 1883, my attention was called to the peril connected with drinking the Passaic water during cold weather and especially when the river was covered with ice. I had been asked by the Commission of Engineers, consisting of Messrs. Cheeseborough, Vaughan Merrick, and Fred. Gräff, to determine the causes of the excessive foulness and nauseating taste and smell of the Philadelphia water during the months of January and February of that year. The analyses showed that the oxygen gas which should always be present in properly aerated water, had been mainly used up in the oxidation of the sewage pouring into the Schuylkill at Manayunk. The oxygen having been used up, and the river at the time being covered with ice, the water had no opportunity of taking up a fresh supply of oxygen from the air. Under these circumstances the excess of sewage, with all its virulence in the breeding of disease, remained in the waters unoxidized and unchanged. I took some of this

Philadelphia water and submitted it to the action of air under pressure by means of a water-pump. That is, I sucked in air by water falling from a height and then caused this air under pressure to act on the sewage dissolved in the water. The purification was so considerable that Philadelphia shortly afterwards appropriated ten thousand dollars for the purchase of machinery for aerating the water. The same dangerous condition appeared in the Passaic water during the winter of 1883. The river was covered with ice, and the analyses showed that the sewage remained dissolved in the water in an unoxidized and actively poisonous condition.

*Much sickness prevailed at Passaic, where the smell of sewage was readily recognizable in the drinking water, and the symptoms of this sickness were such that it was popularly known as the "water cholera."*

There was no change in the volume of water flowing in the Passaic nor any increase in the volume of its usual pollutions. The *danger arose from the sewage which is at all times present*, but which did not get an opportunity to undergo oxidation when the river was ice covered. The difficulty continued on in March and April, and the fact of the presence of unoxidized sewage in the water as supplied to Newark and Jersey City, was demonstrated by the notable amounts of *nitrous acid* revealed in the analyses of the samples collected at that season.

As to the total amount of sewage entering into the composition of the water during the *spring of 1883*, the analyses made at that time supply the required information. They show that of the total decomposable organic matter present in the water, part of which came from purely natural sources and was harmless, *twenty-eight per cent.*, or more than one-quarter, was sewage.

Having made hundreds of analyses during the preceding three years, in the year 1884 I was able to arrive at the average difference of composition between the pure waters of the upper Passaic and the sewage-polluted water drunk in Newark and Jersey City. In the latter the free ammonia is fifty per cent. greater; the albuminoid ammonia is forty-seven per cent. greater; and the amount of oxygen required to oxidize the organic matters is thirty per cent. greater. The nitrous acid, from



a mere trace and frequently not even that, is increased to easily measurable quantities. The nitrates are fifty per cent. greater; the chlorine is two hundred and seventy per cent. greater; and the total amount of salts and matters of every kind in solution in the Newark and Jersey City water, is one hundred and eighty-five per cent. greater than that which is contained in the Passaic River above the Great Falls.

Now I shall throw out of the calculation the enormous excess of chlorine and total solids. Chlorine is a characteristic constituent of urine, manure and faecal matters, and an increase in the amount of chlorine is ascribed by chemists to the presence of excrement and voidings of the human body in the water drunk. Unquestionably it is so in the present instance. But some of this chloric is also due to salt water brought up by the flood tide. For this reason, and in order to understate rather than exaggerate the grossness of the pollution, I shall leave out of consideration the chloric, and, for the same reason the one hundred eighty-five per cent. increase of solids also. With regard to the other constituents revealed by analyses, this excuse does not hold good. Their increase is due to sewage and to sewage only.

*I am within the limit when I state that fifty per cent, or one half of the organic matter in the Jersey City water during the year 1884, was sewage.*

It is admitted by everybody that sewage goes into the water supply. Every one with his own eyes can see that it goes in, and that it goes in in very large amounts. But it may be urged that by the time this sewage water has reached the consumer in Newark and Jersey City, the sewage part of it has undergone oxidation. If such is the case, then the sewage will have been virtually destroyed, and only the products of its oxidation will remain, which products are harmless and will not produce disease.

A number of years ago, and before the volume of pollution grew to be so enormous, and the population of Paterson to be so great, this change did occur in the sewage flowing down the river. But such is not the case at present. And, what is far more important than any *theory* as to whether, or no, there is fresh sewage contained in the drinking water of Newark and Jersey City, the analyses show the fact. Not only is it present, but present

at all seasons, winter, spring, summer and autumn included. This fact is proven by the measurable amounts of nitrous acid, (the presence of which substance indicates the existence of unoxidized sewage), and which, though some times absent, I have found at all these seasons of the year.

*And so most lamentably it has come to pass that after a flow of sixteen miles in an open stream, and after two-thirds of the Paterson sewage has been oxidized and destroyed, the third remaining is reinforced by the sewers at Passaic, Newark and other points to such an extent that the organic matter in the drinking water is one-half sewage.*

#### QUESTION THIRD.

*Is the water at present supplied to Newark and Jersey City dangerous to health?*

#### ANSWER.

This is as though I were asked, is drinking sewage dangerous to health? I believe it to be not merely dangerous, but so fatal that thousands of people are killed by sewage-drinking every year. A few illustrations will suffice. In the year 1849, out of a population of 2,286,800, 14,137 were killed in London by a visitation of cholera. This was 61.8 out of 10,000 people. In 1854, its population was 2,504,198, and 10,738 lives, or 42.9 in 10,000, were destroyed by the same dread disease. In the year 1866, out of a population estimated at 3,037,991 cholera slew 5,596 persons, or 18.4 per 10,000. In 1849 the Thames was very much polluted; in 1854, the pollution had been lessened, and in 1866, the condition of the Thames water had been much improved by filtration and other means, but enough sewage still flowed into it to produce this frightful mortality from cholera.

Speaking of this matter, my friend Col. Ludlow, now Engineer Commissioner of the District of Columbia, but at the time of making these vigorous remarks in relation to the sewage-polluted waters of the river Schuylkill, the Engineer in Chief of the Water

Department of Philadelphia, wrote:—"I was in St. Louis in 1866 when out of a population of 200,000, 3,527 people died of cholera—a death rate from this cause alone of over 17½ per thousand. The trade of the city was completely crushed for the entire Summer, and I well remember the dread and anxiety depicted on every face, and the deadly pall that hung over the city, which the gutters, reeking with the pungent odor of chloride of lime, and the black smoke of the blazing tar-barrels, converted into a veritable Gehenna. \* \* \* To-day, St. Louis, though abundantly supplied with wholesome water, permits the existence of over 7,000 wells, from which more than half the houses take polluted water for domestic use. St. Louis is simply insisting upon another epidemic."

"The outbreak of cholera in Europe last Summer (1885), was traced beyond question to pollution of the water supply in Marseilles and Toulon, in Genoa and Naples, while neighboring cities, whose water supplies came from beyond the march of the spreading contagion, escaped. The cost to the victimized communities in actual loss of money could not have been less than one hundred million dollars, and was perhaps twice that amount." (Report of the Chief Engineer of the Philadelphia Water Department for the year 1885, p. 129.)

The particular pathogenic microbe, or as it is popularly called, the disease-germ, which originates cholera, when taken into the human body, is the Cholera Bacillus. Despite the protestations of Pettenkofer and the few who still think with him, there is abundant reason for ascribing the propagation of cholera to this bacillus diffused through drinking water.

*I do not know how, in the present state of affairs, a visitation of cholera as fatal as that in London in the year 1849, could be prevented in Newark and Jersey City, were this epidemic to break out during the coming Summer in the towns using the Passaic River as their common sewer and water supply.*

During the Spring of 1885 I visited the town of Plymouth, located on the Susquehanna River, opposite Wilkesbarre, in Pennsylvania. I walked up a mountain stream back of the town,



until I came to the farm house and found the man convalescing from that attack of typhoid fever, which had been so fatal to multitudes of others. The farmer had been ill during January, February and March. His excreta had been thrown directly from the back piazza of the house upon the frozen ground below, a little ridge intervening between this ground and the steep bank sloping down to the brook. At the end of March a rain and thaw occurred and the dejecta were washed into the brook. Fifty cases occurred in fifteen days from this time. At the date of my visit, out of a population of 8,000, 1,300 persons had been ill, and more than a hundred had died of typhoid fever: the town had been one great hospital, schools had been suspended, and the school-buildings had been used to take care of the sick. Inasmuch as the period of incubation of typhoid fever is somewhere between ten days and three weeks, and inasmuch as those who at the beginning of the epidemic used well-water exclusively had not been sick, and inasmuch as the autopsies of Dr. Shakespeare, who was sent by the Mayor of Philadelphia to report upon this scourge, revealed the characteristic lesions and other marks of typhoid in the persons dying of this epidemic, there can be no *question that it was typhoid fever and that it was originated in the water supply of a town of 8,000 people by one man ill of this disease, his dejecta getting into the river three miles away from the town, following the river downward through its several reservoirs, and then poisoning the water taken in at every house tap. But there is no substantial difference between the circumstances at Plymouth, and the relative locations of Jersey City and the sewage of Newark, Dundee and Paterson, except that in the latter case the Passaic river, which carries the typhoid germs, is of larger volume and more of the shots fired by the typhoid cases at Dundee and Paterson go wide of the mark—very many hitting, nevertheless.*

Whilst the taste, odor and amount of putrefying filth in the Passaic water is ordinarily greater in the Summer and Autumn than in colder seasons of the year, I am by no means persuaded that it is most dangerous to health during the times when it tastes

worst. I have already alluded to the comparative slowness with which its sewage undergoes oxidation and destruction during the colder part of the year, and a typhoid germ would be quite as potent then as at other seasons. Nor is its virulence restricted to the production of typhoid fever only, for typho-malarial and other zymotic diseases frequently have the same origin. During a great part of the year much of that general malaise and debility, which large numbers of people suffer from, is partly attributable to the cumulative action of the sewage-polluted drinking water upon their systems.

#### QUESTION FOURTH.

*What in your judgment will be the best place and method for obtaining a supply of pure and wholesome water for Jersey City and Newark?*

#### ANSWER.

Unquestionably go at once to the undefiled and unpolluted waters of the upper Passaic above Paterson. They come down from a drainage-area of well-nigh 900 square miles underlaid by granite rocks and forest-covered. Many analyses which I have made for the State Water Commission and for the Joint Board show these waters to be of great purity. By the building of storage reservoirs a practically illimitable supply, equal in excellence to the best in the United States, can be obtained for all time to come.

There is only one other source of supply which merits attention, and that is the Morris Canal scheme. To study this scheme with sufficient care I went by boat and on foot along the whole canal as far as Lake Hopatcong.

*After tramping over the drainage area of this and other gathering grounds draining into the canal, I was convinced that the quality of the water was so inferior, and the quantity available for the great needs of the future so inadequate, that the Morris Canal scheme cannot be recommended and should never be adopted.*

But the expenditure of money will be so great, the engineering work so vast, that whether the pure waters of the upper Passaic are brought into Newark and Jersey City by municipal or private enterprise, a number of years must elapse before such a colossal undertaking is accomplished. Shall the citizens of Jersey City and Newark be compelled in the meantime to drink the unpurified waters of the lower Passaic with all their death-dealing load of sewage? The very thought of such a thing is monstrous, and the possible consequences, in case of an epidemic of typhoid fever or cholera among the 250,000 people sewerage into these waters, horrible beyond the power of the imagination to conceive.

I believe there is a criminal responsibility in not utilizing the means which science has placed into our hands for reducing as far as practical, by artificial methods, the terrible risks these two cities are at present taking. Not a day should be lost in putting into operation effectual purifying and filtering plants at Belleville. The additional cost per million gallons would not be great, while the benefits to life, health and property would repay the outlay an hundred-fold.

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*Extract from the arguments made before a Committee of the Senate of New Jersey, upon a proposed bill to authorize the damming of the Passaic River at or near Bellerille, February 21, 1882.*

EX-GOVERNOR LEON ABBETT.

“That the water is impure and that it can be made purer are two facts which no one will deny. It is impure from various sources. It is impure because the city of Paterson pours its sewage into the river, because the city of Passaic turns its filth into *the stream. More than that, below the water works of the two cities the sewage of Newark is backed up by the tide flowing up, and when it is thus backed up it pours its pollution into the water that the inhabitants of both the cities must drink.*



In addition to that, when the tide sends the salt water up, that pollutes it. \* \* \* \* \*

“The fact is, that our water is impure and unwholesome, and the sources of pollution are shown to the public through the press, and if we are to have the salt water and sewage from Newark added to the impurities flowing down the stream, why, we must find relief somewhere.”

ANDREW CLERK, Esq.

“Surely the health of some 300,000 people who drink the water daily, ought to have some consideration with your honorable body, and I tell you unless the bill is passed it will be the death blow to the prosperity of Jersey City and Newark: for in a very few years, certainly within five years, the water will not be fit for human beings to drink. Those who have the means will leave us, and there will none come to take their places; the poorer classes and those who have their all invested here will be the greatest sufferers.”

WILMON W. C. SITES, Chief Engineer of Jersey City.

“The recent improvements in the navigation of the Passaic river, made by the National Government in the removal of reefs and other obstructions to navigation, have resulted in allowing a greatly increased volume of salt water to enter the river from the Bay at each flood tide, and during the period of least flow in the river; a flow of salt water is forced up the stream far above the ‘Intakes’ of the Jersey City and Newark works, so that in a dry season when the volume of fresh water coming down the river is reduced, the water that is drawn from the stream for the use of the two cities, contains a very large percentage of sea water. From the result of a long series of chemical analyses made during the dry season of last summer, by Prof. Albert R. Leeds, of the Stevens Institute of Technology, at Hoboken, chemist to the Water Boards of both Newark and Jersey City, it was found that the amount of sea water thus taken in with the water supply of Jersey City was, at high tide, 30,000 gallons to every million gallons of water pumped, while at Newark it was 8,000 gallons to the million. The evil results of this admixture of salt water

is felt not only in the water used for domestic purposes, but is destructive to steam boilers and endangers their safe use by reason of the incrustation of salt within them. In addition, it renders the water unfit for use in many industrial establishments, where pure water is a necessity, and results in great loss, directly and indirectly, to the people of all the cities using the water. In *addition to the evil of salt water, the flood tide carries with it great quantities of sewage of the city of Newark and the town of Harrison, which sewage is forced into the reservoirs of both cities by our pumps.*

*Extract from the Annual Report of the State Geologist of New Jersey* (Prof. GEORGE H. COOK) for 1886, p. 210.

“The Passaic river, at Belleville, from which the supplies for Newark and Jersey City are now pumped, is disgustingly impure, and is constantly liable to dangerous contamination. With sources of supply unquestioned in purity, and more abundant than those used for the supply of Boston, New York, or Philadelphia, and at a manageable expense, there is no justifiable excuse for longer delay in the introduction of this element so essential for health, comfort, and cleanliness.”

*Extracts from the Annual Reports of the Board of Health of the State of New Jersey.*

SIXTH ANNUAL REPORT, 1882, p. 8.

“The two largest cities of the State, and much of the thickly settled surrounding country, derive their supply of water from a stream defiled by the emptyings of manufactories and sewers for miles above the point at which it is drawn. This condition of affairs must continue to grow worse, since the natural growth of the communities increases alike the demand for pure water, and the contamination of that upon which they depend.”

SEVENTH ANNUAL REPORT, 1883, p. 83.

“Foul liquids from graves may enter and pollute a stream, \* \* \* and if the water be used for drinking, injury to health may result. \* \* \* It is necessary, therefore, in order to obviate risk

from this cause, that a cemetery should have a suitable soil, and be properly drained, and that it should be at a sufficient distance from subterraneous source of water supply; and in such a position, with respect to them, that the percolation of foul matters from one to the other may be impossible."

EIGHTH ANNUAL REPORT, 1884, p. 8.

"It cannot be claimed that the unfitness of the Passaic river, as a water supply, is any new fact, although the rapidly increasing population magnifies the greatness of the evil. Long ago the State Geologist and various local correspondents pointed to the facts in evidence. Chemists and others who have begun investigations with the idea that the evils have been magnified, or that they could be remedied by local action, have forsaken such views. The State Water Commission and the chemist of the water boards fully substantiated views already entertained."

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*Extract from an Account of the Annual Inspection of the Jersey City Water Works by the Mayor, the Board of Works, and the Board of Finance, of Jersey City, taken from The Evening Journal of May 5, 1887:*

"The Commissioners and guests were next conducted to the Passaic River, where the water is taken in. A conduit—'sewer' would be a better name for it—about 10x8, runs from the river to the engine houses, through which the water is drawn by the suction of the ponderous pumps. Fully an hour was spent at this point considering the matter of increased facilities and improvements to insure a greater supply of water, which is admitted by all to be a growing necessity. At low-tide there is less than five feet of water from which to draw a supply, and in consequence it frequently becomes necessary to stop one of the engines until the tide runs up again. Another serious difficulty is, that while pumping at low-tide, all the filth at the bottom of the river at the mouth of the conduit is drawn in by the force of the suction of the pumps.



“The Mayor had very little to say in this regard, but he did not favor any of the improvements suggested. He was more than ever impressed with the fact that Passaic water is unfit for use at the best, and will not sanction the expenditure of any large amount unless the supply of water to be obtained is of a better quality than that obtainable at the present site. While standing upon the brink of the river yesterday, he remarked to the *Journal* reporter: ‘Look at the color of that water. The tide this minute is running up at the rate of three miles an hour, bringing with it the filth and refuse of the whole city of Newark, a portion of which is sucked into the pipes, passed up into the reservoir, and thence through the mains into the dwellings of our citizens.’

“Chief Engineer Kearney, who has charge of the works, conducted the visitors to the screen house, which is a small brick building about midway between the river and the engine room. Here he explained the manner in which the water is filtered by the use of wire screens. One of these, the meshes of which are about two inches apart, is placed at the mouth of the conduit. The second one, a little finer, is placed in the conduit at the screen house, and the third, a still finer one, is placed at the engine house end of the conduit. In speaking of these screens, or filters, Mr. Kearney said: ‘We often take them out for the purpose of cleansing them, and not infrequently find pieces of cats and dogs, rats, old hats, and other refuse and decayed substances wedged in them.’ This was interesting intelligence for the Commissioners, and they bid the locality adieu in short order.

“While the Commissioners were at the river bank the Pollution Boat ‘Patrol’ came along and stopped for a few moments. Inspector Leake had been up the river collecting samples of refuse waters emptied into the stream by manufactories. He had several demijohns full of impure water for the purpose of analysis.

“While the new Commissioners were well pleased with the magnitude and completeness of the works, nearly all were much displeased with the quality of the water obtained, and characterized it as wholly unfit for domestic purposes. Said Commissioner

Hilliard: 'Any one that will drink that water will drink anything.' "

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*What prominent people of Jersey City think of Passaic Water as now supplied to them by the City. Compiled from published interviews in the Jersey City newspapers.*

Rev. JOHN L. SCUDDER, pastor of the Tabernacle.

"What do I think of Passaic water? Why it is not fit for a hog to wallow in. It is the vilest and filthiest water that anyone ever looked upon, and the idea of drinking it is like taking so much refuse from the sewer into ones stomach. I hate to wash in it, it is so nasty and offensive, and I wouldn't dare permit any of my family to drink it until it is first filtered and then boiled."

Rev. S. M. RICE, D. D., late rector of Grace Church.

"The Passaic water is dangerous for use in view of the circumstances of cholera and contagious diseases breaking out in any of the cities along the banks of the river. In that case the germs would certainly be carried to Jersey City, and the contagion would spread frightfully. I never drink the Passaic water until it is distilled."

Rev. E. L. STODDARD, D. D., rector of St. John's Free Church.

"I think something should be done to give us purer water. I always filter and boil the Passaic water before using, not daring to use it otherwise. I know plenty of people who are constrained to resort to the same precaution, and that, it seems to me, tends to show that the water is regarded as impure and dangerous. To be sure, I am in favor of anything that would render so necessary an article of general use wholesome and healthy."

Mgr. ROBERT SETON, D. D., pastor of St. Joseph's Church.

"I am horrified to think that we are obliged to drink such vile stuff as the Passaic water. I think it would be a good thing to call a public meeting of our citizens together to consider this water question."

Rev. I. W. HATHAWAY, pastor of the Westminster Presbyterian Church.

“Many people who would make excellent citizens are kept away from Jersey City on account of our horrible water. The city is making a great mistake by pursuing a penny wise and pound foolish policy. We should have pure water as we value the lives of our citizens. I sometimes almost wish that another Boss Sheppard would appear in Jersey City who would, by robbing it, bring the city to its senses and arouse interest in vital public questions. I stand in favor of pure water as a matter of crying necessity, and would gladly do all in my power to bring about its introduction in this city.”

Rev. FREDERICK E. MORTIMER, rector of St. Mark's Church.

“The Passaic water is hardly fit to bathe in let alone to drink. It is certainly too vile to drink, and I know a great many people who would not touch it. How can temperance and sobriety be expected to flourish in this city when the water is so execrable?”

Mr. ABRAHAM S. JACKSON, the lawyer, entertains an unspeakable dread of the Passaic water.

“‘I haven't drunk a drop of it in ten years,' said he last evening, ‘nor has a member of my family. Ever since 1874 I have been getting drinking water from New York. I would be afraid to drink the Passaic water. Several times I have made up my mind to make a presentment to the Grand Jury, asking that an inquiry be instituted regarding the question as to whether the city can lawfully collect water taxes in the present condition of affairs. The language of the water act requires that the city should supply us with ‘pure and wholesome’ drinking water. I don't think there would be any difficulty at all in showing that the Passaic water is neither pure nor wholesome. If that point were well established the city couldn't collect a cent of water tax until it would fulfill its part of the contract by supplying us with pure water. The only thing that has kept me from making a test case of the matter was the fear that Jersey City might thereby be plunged into financial embarrassment.’”



REV G. P. HEBBERD, pastor of Holy Trinity.

“The very thought of drinking water from a sluggish river, into which constantly empties the sewage of several towns and cities, is horrible and revolting.”

DR. JOHN LOCHNER.

“The Passaic water pure? Nonsense. It is horrible, and absolutely filthy. I never drink it myself, because I regard it as dangerous. It is polluted with poisonous and decayed matter, and smells and tastes as if it were rotten.

“How can such water be pure? The people of Jersey City are actually drinking sewer water, for the Passaic river is nothing else than a vast sewer. What we want is clear water from a pure source. The inhabitants of Jersey City have been drinking filth long enough.”

DR. J. W. HUNT.

“There is no doubt at all that the Passaic water is bad and unwholesome. The sooner we can have unpolluted mountain water the better.”

DR. MCGILL.

“The Passaic water looks bad, and it ought to be condemned on its looks, if nothing else. I have three or four filters in my house, but I don't trust them, and always boil the water before using. I wouldn't allow my children to drink it when it is not boiled, and I invariably tell my patients to boil the Passaic water before using. I don't want to take any chances on a doubtful article.”

DR. A. HOLCOMBE.

“The stuff taken from the Passaic river, and which is used in this city as water, is simply abominable, execrable. I wouldn't allow one of my patients to use it unless it was first filtered and then boiled. Such water is liable to cause typhoid fever, diarrhoea and other diseases, and is most dangerous especially for children to use. The people of Jersey City drink worse water in my opinion than that of any city in the United States.”

## Dr. J. H. FINNERTY.

“I fear the people are not awake to the importance of having pure water to drink. The Passaic water is certainly impure and dangerous. It is filled with decomposed animal and vegetable substances, and at certain seasons of the year is like so much filth taken into the human system. It is cruel to give such a beverage to weak children, and it is a burning shame that we cannot have pure water. A frail patient cannot even bear the Passaic water on his stomach, it is so rancid and disgusting.”

## Dr. A. J. LOOMIS.

“The Passaic water is filthy and abominable, and during the past year it has been growing more impure all the time. Even filtering is of no use so far as cleansing it is concerned. I am certainly in favor of a new water system which will supply Jersey City with water fit to drink.”

## Dr. F. SELNOW.

“Our water is about as bad as it could be—chock full of impurities and decayed matter. I am among those who are in favor of having pure water from the mountains.”

## Dr. S. W. CLARK.

“The water used in this city is very bad indeed, and cannot but be dangerous to health. *I attribute the typhoid conditions and low forms of malaria, which, especially in the fall of the year fasten upon nearly all diseases, to the impure Passaic water which the people are obliged to drink.* Filtering I find to be practically useless, as it will not, no matter what is said in its favor, destroy the germs of disease found in decayed vegetable and animal matter, nor will it remove disease-breeding particles in solution. Nothing could be more dangerous to the public health than foul water, and I don't see how the water of Jersey City could be any worse than it is. Sewage-polluted water is like so much poison in the stomach.”

## Dr. M. R. PETRIE.

“There can hardly be any difference of opinion as to the quality of the Passaic water. Whether it contains this or that

impurity is a matter for chemists to grumble over; but the one striking feature of it is that it is unfit to drink. It is reeking with filth and rotten animal and vegetable matter, as any one with half an eye can see. The water is always bad, but sometimes it is villainous. It tastes bad, it smells bad, and its appearance is absolutely nasty."

Dr. J. D. VAN SAUN.

"What do I think of the Passaic water? I think it is vile. How can it be otherwise when it is polluted with all kinds of poisonous die stuffs and filthy sewerage? Impure water is a constant menace to the lives of every man, woman and child, and the only way to remove the danger is to change our present filthy Passaic water for the pure mountain beverage."

Dr. W. A. DURRIE.

"The Passaic water is certainly bad, suspiciously so, and I would like to see pure mountain water substituted for it."

Dr. H. L. LOCKWOOD.

"The water we drink is unqualifiedly bad and unfit for human consumption. We get the full benefit of the Paterson and Newark drainage, as those two cities are too close at hand for the water to be purified by a natural process in the flow. The Passaic cannot possibly escape contamination. It is filthy, and I can't get it out of my mind that it contains germs of disease. Pure water is the greatest blessing a city could have, but the Passaic water is a curse."

Dr. E. A. CUDLIP.

"While the sewage of Paterson and Newark flows into the Passaic river, any typhoid diseases existing in those cities may be communicated to the inhabitants of Jersey City who drink the Passaic water. We are badly in need of pure water and I think we ought to have it."

Dr. W. M. P. WATSON.

"Of course I think the Passaic water is not fit to drink, and the sooner we are rid of it the better. Filtering is of no use. It



may remove the muddy appearance of the water, but that is not where the danger lies. It is the poisonous solutions in the water which are hurtful, and these filterings cannot destroy. *There is no doubt that it promotes malaria and augments diseases already existing.* I never allow children, especially infants, to use it until it is boiled. By all means let us have pure water."

Dr. HOFFMAN.

"The Passaic water is bad. Jersey City should have water from the mountains."

Dr. KEATING.

"I'm afraid the Passaic water works more harm than people have any idea of. It cannot be wholesome, coming from the source it does."

Dr. ADAMS.

"The water we drink is far from being pure, and we need a change. Sick people had better let the Passaic water alone."

*Said a representative of the firm of Matthiessen & Wiechers, sugar refiners:*

"We require a great deal of water in our business, and we need pure water. The Passaic water is vile. It's so filthy that we have to filter it before we can use it, and then it is far from what it should be. It requires at least 20 per cent. more of the Passaic water to run our boilers than it would of the Croton water, for instance, and the water is so foul, and it contains such chemical properties that scales form on the inside of the boilers almost as rapidly as we can scrape them off. We have to let the boilers run cold every few days on that account, and in that way we lose a lot of time. It is too bad that we cannot have pure water in Jersey City, but instead of any improvement the water is doubtless growing worse."

Mr. BETZ, of the firm of Lembeck & Betz, brewers.

"As everyone knows, a brewery requires decent water. We have to filter the Passaic water before we can use it at all. Last

summer the water became so offensive and foul that it was terrible to look at. It was muddy and nasty in appearance, and it smelled horribly. I sincerely hope it may not get so bad this summer. We should have pure water and I trust we shall soon get it."

WILLIAM R. LAIRD, druggist.

"We need a new and pure water supply in Jersey City, in the worst way. I never drink the Passaic water, nor do I allow my family to use it. When I use the Passaic water for any purpose I always filter it. There is a growing demand among private families for bottled spring water, which goes to show that the public is afraid to drink the Passaic water. I never sold so much bottled water as I am disposing of this season. With so many pure mountain sources as we have to draw from, I think some effort should be made to obtain pure water for Jersey City."

EUGENE HARTNETT, druggist.

"I always filter the Passaic water before using it. I think we should have as pure water as possible."

GEORGE W. CLERHEW.

"It would be a good thing if we could have better water."

Mr. VAN ANGLE, of the firm of T. C. Brown & Van Anglen.

"I use spring water altogether, and I haven't drank a glass of the foul Passaic water in three months. A city needs wholesome water almost before anything else. It is a pity we cannot have a pure water supply."

WM. SYMES, restaurateur.

"It is something frightful to think that we are forced to drink water into which flows the undiluted sewage of several cities. Of course, I say we should have pure water."

*Extract from an Article in the Evening Journal of March 11, 1887.*

"Jersey City is vitally interested in a scheme, legal notice of the adoption of which is published to-day in the local news-

papers of the city of Passaic. It consists of a plan of sewerage for the entire city, which of late has had a phenomenal increase of population. Passaic heretofore has, outside of a few private drains, been without sewerage. Its authorities have become aroused to the danger of going on longer without drainage, and have decided to sewer the city. They propose to construct the sewers so as to empty into the Passaic River, from which this city, Newark, Bayonne and Harrison draw their water supply.

“The Passaic authorities have also proposed to utilize a stream known as the ‘Tail Race,’ which eventually reaches the Passaic River. In short, Passaic City does not propose to assume the expense of disposing of its sewage by artificial means. All sorts of schemes to dump the filth from the sewers into the river, will be brought into use.

“The sewers will vary from six to twenty inches in diameter, and are to empty into the river direct or into the ‘Tail Race.’

“The specifications call for seven main lines of sewers and numerous branches. They aggregate 264,880 feet, or about 50 1-6 miles of sewers of various sizes.

“Should the Board of Pollution fail to prevent the building of the sewers, it may be gratifying to know that the action of the automatic flush tanks will be to evenly distribute the filth of Passaic into Jersey City’s water supply. It will not come to us in great masses but be thoroughly mixed. Jersey City’s residents will have to submit to it unless a new source of supply is secured.”

*Extract from an Editorial in The Passaic Daily Times of March 25, 1887.*

“That the active measures taken by the City Council in regard to a new system of sewerage should receive the hearty endorsement of all the residents of Passaic, no intelligent person, who has the welfare of the town at heart, can doubt. Our present system of drainage is woefully deficient, and the health of the people is already beginning to suffer on account of it. That *the Passaic River is the natural and only means by which a proper drainage can be effected, is also equally clear. The serious objection to the movement lies in the fact that Jersey City*



*and Newark both draw their water supply from the Passaic River; but these towns have already been suffering so greatly from drinking a water that is totally unfit, that any measure that would compel them to abandon it, and look elsewhere for their supply, would be the best thing that could happen to them."*

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[From the Tenth Annual Report of the Board of Health of the State of New Jersey, page 133.]

## THE RELATION BETWEEN DRINKING WATER AND TYPHOID FEVER.

[Paper read before the Board of Health of the State of New Jersey.]

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By DOWLING BENJAMIN, M. D., of Camden, N. J.

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"Typhoid fever is caused by a peculiar and specific poison. I do not know that this is denied to-day by any one competent from careful study and thorough investigation to give trustworthy information on this subject. Does it arise *de novo*? All the investigations that I have made have proven to my mind that the poison which produces typhoid fever cannot be generated spontaneously, but must come from another case. I am aware that there are some physicians who even now believe that it originates *de novo*, and they give the examples and cases which prove to their minds the truth of such belief. But the cases cited as proofs, in my opinion, are generally defective, and do not exclude the possibility of infection from a preceding case.

"What are the physical characteristics of the virus of typhoid fever? Is this virus a liquid, a solid, or a gas? Evidently it is a matter of some kind. Inorganic matter may be either solid, liquid or gas; organized matter is never liquid, never gas. We conclude it is not a gas for the following reasons:

"*First.* The gas has not been isolated.

“*Second.* It would be more apt to go through the air than otherwise, which is not the case with this virus.

“*Third.* All known gases that affect the system profoundly, or that affect the system at all, do so at once, or in a few minutes after their reception into the system.

“Can a dose of carbonic-gas, ammonia-gas, illuminating-gas or any other poisonous gas be taken and lie in the system for from two to six weeks and then begin to develop a train of trouble—a uniform succession of symptoms, like typhoid fever, or small-pox, or any other of the zymotic diseases? Never. Is it a liquid—this virus? The same objections apply to this theory that apply to the theory of its being a gas. Is it composed of solid particles? If so these particles must be of nearly the same specific gravity as water. There is no evidence to the contrary, at any rate, and these solid particles must be very small, for water known to contain typhoid fever poison is often apparently clear and bright. *Filters do not seem capable of sieving out these particles*—these poisonous particles, and this poisonous matter. At least, water has been filtered through 10 and even 100 feet of sand and earth, coming out clear, but still bearing the poison in sufficient quantities to produce fever and cause death. *So far as is at present known the poison has not been filtered out of the water by any kind of filter.* This would lead us to think it was really dissolved in the water, but for the fact that a system of very fine filtration has not been tried upon suspected water, and then the water given to persons to drink, to see if the disease would be produced by it. There is no case on record of any person ever having taken the disease from water that has been boiled, thus showing that, as far as known, the boiling temperature destroys the poison.

“The theory that the poison of typhoid is an organized poison, or germ, or bacillus, seems to explain its action more completely than any other\*. This phase of the subject was carefully discussed, and its progress given at length by me in an essay written in 1876, and published in “The Country Practitioner,” Volume 2, Nos. 6 and 7. Whatever may be considered the na-

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\*Klebs and Eberth both claim to have discovered the bacillus.—*Phila. Med. Times*, Dec. 3, 1881.

ture of this virus, the fact that water is its principal distributor is certain. Indeed, a careful study of the cases and statistics that I have examined seem conclusive *that at least 95 per cent. of the cases of typhoid fever come directly from the water.* The poison which produces this disease does not go through the air. Physicians permit people to go into the sick-room where this disease exists. Washerwomen have been known, in rare instances, to take the disease from the water containing the soiled linen, which has infected their hands and gotten into the mouth and absorbents. The infected wash-water is very often thrown on the ground near a well, or into the sewer with the more poisonous dejecta. I have seen two cases that occurred among sailors who drank water from the Delaware river, opposite the Philadelphia sewers.

“ There is one instance † where it has also been shown that cattle have been afflicted with this disease, but in tracing the disease still further back it was found that the cattle caught the disease from drinking infected water. The milk supply has also been known to become affected. So the more we investigate the subject the more strikingly the fact stands out that water is the main habitat of the poison. Several facts show, also, that when water contains a little organic matter the virus will be active for at least a year in still water, and very probably for a number of years, as some of the cases cited prove.

“ The ways in which a well, or a spring or stream may become affected are so numerous and hard to trace that sometimes they defy detection. For instance, a man may leave the city where typhoid prevails more or less at the time, and be either in the first stage of the disease, in a slight form, or convalescing, or be a walking case, perhaps not even knowing what is the matter with himself, getting out of his carriage or a railroad car, takes his gun for a few hours' recreation, and, as it so often happens, is seized with a desire for evacuation. This may take place in the vicinity of a spring or stream of water, whence will thus start up one or more cases of typhoid fever, and the manner in which that water became infected will forever remain in doubt and a mystery. Even the persons in that locality may not know

† Klotten, Germany, 1878.—Berlin *Klein Wochenschrift*.



of anything of the kind, or they may have known of the presence of such a person, and may have forgotten it.

“*Recent investigations show the intimate relations of this disease to drinking water to be so close and so constant that it is hardly ever worth while to think of any other source of the contagion.* One of the most remarkably clear examples of this relation of drinking-water to typhoid fever occurred last year at Plymouth, a small city in Luzerne county, Pennsylvania, and for the invaluable lessons taught by this epidemic we owe much to the committee sent by the Mayor of Philadelphia to investigate the subject. I quote from the report of the committee, as follows:

“‘The mountain stream is a small one, running down over a rocky bed, and on a declivity not eighty feet from its bed a dwelling is situated, wherein, during January, February and March, was located a case of typhoid fever, that is only now convalescent, the worst period of the case being about the twentieth of March. The attending nurse was in the habit, during each night, of carrying the excreta from the patient and depositing it on the ground towards the stream. The ground during all this time was frozen and covered with snow, until the thaw and rain, already alluded to occurred. The poisonous character of the dejecta is not destroyed by freezing, but is only kept in a state of hibernation. A great part of the three months’ accumulation of dejecta was suddenly swept into the rapidly running stream, and reached the lower reservoir, as quickly as a man walking fast could have arrived there.

“‘In fifteen days from this time the epidemic began, fifty cases occurring daily between the tenth and twentieth of April. Up to the present, twelve hundred have been sick, and one hundred have died, out of a population of eight thousand. For the first three weeks the few people in the town who used well-water exclusively escaped the disease. The period of incubation varies between ten and twenty days, or longer, and therefore no other conclusion can be arrived at than that the infective poison existed in the mountain water, and originated from the one case of fever in the house on the side of the stream.’

“This entire and comprehensive report is on file in the Mayor’s office, Philadelphia.

“Last October a severe epidemic of typhoid was in progress in Imlaystown, N. J., about 40 miles from Camden, and I went out there to investigate it, and was greatly assisted in so doing, by the kindness of Dr. H. G. Norton.

“I found that a brook about 4 feet wide runs through the village. A street runs parallel with the stream, about 100 feet from it. A row of houses is situated between the brook and street, and the back-yards extend to the brook, about 40 feet distant. Between the brook and the houses is situated a row of privies, and a row of wells for drinking-water. The privies are situated on the bank of the brook, so that the fæcal matter from them has to run a distance of only 3 or 4 feet to get into the stream. The wells are between the stream and the dwelling-houses, and about 30 or 40 feet from the brook. The somewhat impervious strata has a slight dip towards the wells and underlies the locality. On measuring it was found that the floor or bottom of the wells was not more than a few inches below the floor of the brook, and when the water was high in the brook it was also high in the wells. The soil between the brook and the wells of the privies was porous.

“Beginning up the stream and designating the houses, which are but a few feet apart—not over 50 feet—and numbering them one, two, three, I will give you the following explanation.

“In 1883 a family came to number *one*, suffering with typhoid-malarial fever and diarrhœa. The children had fever and bowel trouble with diarrhœa, lasting for months, until the spring of 1885. On August 14th, 1885, a young lady was taken with typhoid fever in this same house. On August 28th another young lady was taken with the disease in number two, the next house below—down the stream. August 27th a patient at number three took the disease. September 12th another patient took the disease in number three. In September a relative of the family in number *two* visited the town, drank the water, and died in a few weeks afterwards of typhoid fever. September 30th a patient opposite to number two took the disease. In the spring of 1886 the family had moved out of number two, the well had been kept closed and had not been cleaned out. A new family moved in number two in April or May, 1886. The boys drank the well-water, in spite of protests, and took the disease in June, 1886. One of the brothers died. The girls, who would not drink the water, escaped the disease.

“An analysis of this water from the wells, for the State

Board of Health, by Professor H. B. Cornwall, of Princeton College, showed the water to be thoroughly contaminated with organic matter. Evidently the virus had remained in one of these wells; a year had passed and yet the winter had not been able to kill it.

“The length of time that the virus will remain active has not been ascertained, but it is known to be years in water that is not much disturbed.

“I have cited these examples because they are so recent and so near at hand. Hundreds of instances might be cited, and the evidence piled up almost *ad libitum*, but if further examples would not be superfluous in this paper, the time allotted to me would preclude my citing them here. I might say now that much of the data upon which my remarks have been based is not included in this paper for the same reasons.

“In the face of what is already known, I do not think that any student of sanitary science can deny that the poison of typhoid may be carried by the water supply. I do not know that any do deny this, but the *extent* to which it is carried by water, and the preventability of the same, are the great points that do not seem to be sufficiently appreciated by us, and scarcely appreciated at all by the people in general.

“If the people can be made to understand that almost all the cases of typhoid fever come from the water-supply and that there is no disease more easily prevented than this, we shall have accomplished the first great step towards the annihilation of one of the worst destroyers of mankind.

“Look at the dreadful suffering caused in Philadelphia and Camden to-day by ignorance or indifference to these facts. Only a few days ago a noble wife and young mother died in our city of this dread disease, thus blighting the prospects of a happy family, and as I stood by her bedside I could but regret that another valuable life had been needlessly sacrificed.

“The city of Camden had connected the water-closets and sewers containing the poison, with the water-supply, and then distributed it thus laden with the deadly virus to the inhabitants of this city, but a few hours after it had left the sewers. The husband of this lady ‘as a lamb dumb before its shearers, opens not



its mouth,' so he paid his water-tax to the city, his wife drank the dearly-bought 'distillment' and gave up her life as the result.

"Is there no redress? Is there no hope of escape for the people in these great cities? Must they continue to die by hundreds, as the death returns show every year, at a greater cost and expense than pure water could be procured for? Philadelphia also pours the poison into the cup and then puts it to the lips of her citizens, *and kills off about 700 of them a year*, according to the official report.

"The disease cannot occur without the virus to produce it, and the virus can be kept out of the drinking water, and it should be kept out at any cost. It would pay at *any price*. *Every death that is preventable is needless, and is a reproach to the community*. Dr. E. O. Shakespeare, an eminent investigator of contagious diseases, who has been sent abroad by the highest executive authority of the United States to investigate the nature and causes of cholera, says, in the 'New York Medical Journal,' January, 1885, 'that epidemics of typhoid fever are absolutely preventable and controllable, and neglect to employ proper means for this end should be regarded as inexcusable.'

"Great reforms and revolutions have taken place within our own recollection, and the student of sanitary science fondly dares to indulge the hope that even during his short life he may have the pleasure of seeing the death-rate from typhoid fever reduced more than ninety per cent."

### DEATH RATE STATISTICS.

Death rates of Jersey City and Hoboken, compared with reference to Hoboken's change of water supply in 1882, compiled from the annual reports of the Board of Health and Vital Statistics of the County of Hudson:

YEAR.	<i>Total Death Rate per 1,000 of Population.</i>		<i>Death Rate per 1,000 from Zymotic Diseases.</i>	
	JERSEY CITY.	HOBOKEN.	JERSEY CITY.	HOBOKEN.
1875 . . . . .	25.9.	30.5.	No report.	No report.
1876 . . . . .	26.8.	30.7.	do	do
1877 . . . . .	22.3.	26.4.	do	do
1878 . . . . .	20.7.	25.0.	do	do
1879 . . . . .	20.3.	22.4.	do	do
1880 . . . . .	22.4.	23.7.	5.9.	6.8.
1881 . . . . .	26.2.	29.9.	8.0.	10.0.
Averages . . . . .	23.5.	26.9.	6.9.	8.4.

Hoboken is naturally more unhealthy than Jersey City, by reason of her large extent of low land and undrained meadows, so that a death rate of three or four per 1,000 higher than Jersey City's was reasonably to be expected when both were using the Passaic water, and was actually the case, as shown above.

(Hoboken changed her water supply from Passaic River water, furnished by Jersey City, to Hackensack River water, in 1882.)

a	1882.....26.0.	24.9.	7.7.	7.7.
b	1883.....21.9.	21.3.	5.2.	4.5.
c	1884.....21.7.	21.1.	5.2.	3.9.
	1885.....22.8.	23.6.	5.9.	5.4.
	1886.....22.5.	22.4.	5.5.	5.4.
	Averages...22.9.	22.6.	5.9.	5.4.

a-(Report of 1882.) "Hoboken had 848 deaths in a population estimated at 34,197, giving a death rate of 24.9, against that of 29.2 in 1881. It was 1.7 below Hoboken's eight year average, and 2.6 below that of the county at large in 1882. This very notable decrease was mainly caused by the falling off of the number of deaths from zymotic diseases, in which class fifty per cent. of the lessening of the mortality is found."

b-(Report of 1883.) "Hoboken's great fall of the death rate, when compared with the average for the past three years, is seen to extend over the entire list, and is most notable in the case of malarial and typho-malarial fever, scarlet fever, diphtheria, diarrhoeal, digestive and intestinal diseases."

c-(Report of 1884.) "Hoboken's rate for 1884 was the lowest for ten years. There was a very marked decrease in number of deaths from zymotic diseases."

From a comparison of the above statistics we find that Hoboken's total average death rate per 1,000 per year, for the seven years previous to her change of water supply, was 26.9, as against 23.5 for Jersey City, being an increase over Jersey City's rates of 3.4 per 1,000; and that for the five years subsequent to her change it was 22.6, as against 22.9 for Jersey City, being a decrease from Jersey City's rate of 0.3 per 1,000, or a total change



or saving to Hoboken of 4.3 lives per 1,000 per year. Of this saving to Hoboken of 4.3 per 1,000, such as may be proved to be due to the decrease in zymotic diseases (other things remaining equal), may be fairly credited to the change in the water supply. We find that Hoboken's average death rate per 1,000 per year, due to zymotic diseases, for the two years previous to her change of water supply, was 8.4, as against 6.9 for Jersey City, being an increase over Jersey City's rate of 1.5 per 1,000; and that for the five years subsequent to her change it was 5.4, as against 5.9 for Jersey City, being a decrease from Jersey City's rate of 0.5 per 1,000, or a total change or saving to Hoboken of 3 lives per 1,000, or 120 lives for the city per year.

This rate, if applied to Jersey City with a population of 160,000, would result in a saving of 480 lives per year.

The total decrease in Hoboken's death rate from all causes as above shown, since the change of water supply, is 4.3 per 1,000, or a saving of 172 lives per year (Hoboken's population estimated at 40,000); this decreased rate, if applied to Jersey City, would represent a saving of 688 lives per year (Jersey City's population estimated at 160,000).

Since the compilation of the above matter the following death rate statistics have been published by the Hudson County Health Board: Average death rate per 1,000 for the first quarter of the year 1887—Hoboken, 20 deaths per 1,000; Jersey City, 22.73 deaths per 1,000.

From the above it will be seen that Jersey City's death rate has been about 23 per 1,000 for the past twelve years, and is about that at the present time, while Hoboken's rate has been steadily decreasing since her change of water supply, and is now, according to the last mentioned figures, 2.72 below that of Jersey City; this decreased rate of Hoboken, if applied to Jersey City, would represent a saving of 435 lives per year.

The April report of the Hudson County Health Board gives death rates as follows: Jersey City, 22.6 per 1,000; Hoboken, 18.9 per 1,000.

Compare this last death rate of Hoboken, viz., 18.9, with its average rate for the seven years immediately preceding its change of water supply in 1881, viz., 26.9, which represents a saving of 8 lives per 1,000 per year, or 320 lives per year, for its 40,000 of inhabitants.

If a similar change in water supply would produce a like change in Jersey City's death rate, it would represent a saving to Jersey City of 1,280 lives per year for its 160,000 of inhabitants.





